Anaktuvuk Pass Vegetation Study: Disturbed Sites

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INTRODUCTION

Anaktuvuk Pass is a Nunamiut Eskimo village located on the continental divide in the central Brooks Range (N 68^0 08', E 151^0 46'). Approximately 300 people live a subsistence lifestyle, with caribou, moose, Dall sheep and fish representing a large proportion of their diet. All-terrain vehicles, primarily ARGO's (8 wheel drive vehicles) are used to access areas around the village during spring, summer, and fall months. These vehicles are capable of driving over the roughest terrain, thereby opening many otherwise inaccessible areas to subsistence and/or recreational activities.

The fourth year of a study investigating all-terrain vehicle (ATV) impact on tundra vegetation was conducted from 30 June to 18 July 1998 near Anaktuvuk Pass, Alaska (McKee and Irinaga 1995, McKee 1996, McKee 1997). This study is in conjunction with a land exchange proposal between the U.S. National Park Service and the Arctic Slope Regional Corporation. The primary objective of this study is to collect data on various habitat types to facilitate monitoring the resistance and resiliency of these habitat types to ATV use. Results from this study will serve as a general resource database for the area and be used to make management decisions minimizing ATV use impacts.

STUDY AREA

The study was conducted near Anaktuvuk Pass, in Gates of the Arctic National Park and Preserve (GAAR), central Brooks Range, Alaska. Sample sites were located along the John and Anaktuvuk Rivers as well as several tributary creeks (Fig. 1). The area is dominated by an arctic climate with a mean summer high temperature of 60^0F and a mean winter low of -10^0F. Annual precipitation is less than 25 cm. The dominant vegetation type is tundra. Cottonsedge tussocks (Eriophorum spp.) dominate much of the landscape with mosses and lichens growing in between tussock clumps. Grasses (Calamagrostis spp., Festuca spp., Arctogrostis spp.), shrubs (Betula nana, Salix spp., Ledum palustre), and several herb species are locally abundant in many areas (National Park Service 1986).

METHODS

Fieldwork was conducted by a biological technician and a field assistant based out of Anaktuvuk Pass; the technician was a plant specialist and the field assistant conducted soil sampling and served a support role (carrying gear, data recording, etc.). Study plots were accessed by foot.

A fixed area plot design was used to sample vegetation and to estimate percent cover of plants. All vascular plants within a 5m X 3m plot were identified to species and percent cover was estimated for each. Plant nomenclature followed Hulten (1968). Lichens were identified only when they accounted for 20 percent or more of the ground cover within a given plot, and then only those species representing 5 percent or more cover were identified. Bryophyte species were not identified but their percent cover was recorded. Plots were randomly delineated using a random number table. Soil data collection was modified from the original protocol (Shea 1994) to simplify our effort. A soil pit was dug next to each plot with a Sharpshooter shovel until permafrost was reached or until substrate content prevented further digging. Soil horizons and texture were determined and organic layer thickness measured. In addition, surficial geology, topographic position, and flooding frequency of the plots were identified. A standardized form was used for data collection (Appendix A), and all of the plots were classified to level IV of Viereck et al.'s (1992) vegetation classification system for Alaska. Plot locations were surveyed with a Global Positioning System and the latitude/longitude were logged for future reference (see Tables 1-2).

Data collection consisted of two phases. In the first phase, baseline data was collected in areas not yet impacted by ATV use. This phase of the study was conducted during the field seasons of 1995-1997. During the 1998 field season, plots were established in areas of ATV impact. Plots were oriented perpendicular to the ATV trail and were established in a variety of moisture classes and habitat types. In addition, a disturbance rating was given to each site to quantify existing ATV impacts in these areas (Appendix B). Impacted plots were photodocumented in the following order: plot identification photo (north-facing view), south-facing view, east-facing view, and west-facing view. All plot locations were recorded on topographic maps (scale 1:63,360).

RESULTS

Sixty-one plots were established in ATV impacted areas during the 1998 field season. Twenty-seven plots were located in the Anaktuvuk River drainage and thirty-four were located along the Kollutaruk Creek/John River area (Figures 2 and 3). During this field season, plots were established in areas of moderate to high impacts [as determined by the Disturbance Rating Scale (Appendix B)] and in a variety of moisture regimes.

The most abundant vegetation type sampled was Dryas-sedge dwarf shrub tundra (IID1b). This type was sampled in plots AKP050, AKP051, AKP052, AKP053, AKP054, AKP055, AKP056, AKP057, AKP058, AKP059, AKP060, AKP061, AKP063, AKP065, AKP066, and AKP070. These plots were dominated by Dryas intergrifolia, and also had a strong component of sedges, mostly Carex scirpoidea. The dwarf willows Salix reticulata and S. arctica were common and forbs such as Silene acaulis and Hedysarum alpinum were locally abundant at some sites. Mosses were usually sparse, but were abundant at some sites. Lichens were common in non-impacted areas of the plots, but were absent or rare in areas that were impacted. Soil profiles for these plots included an organic layer 2.5 to 10 cm over mineral soil (n = 16). Frozen soil was found at depths of 34 to 61 cm on 5 July (n = 4).

Wet sedge meadow tundra (IIIA3a) was sampled in plots AKP073, AKP074, AKP075, AKP076, K040, K041, K043, K045, K048, K049, K053, and K054. These plots were dominated by the sedges Carex aquatilis, C. bigelowii, and Eriophorum angustifolium. Many other species of sedge were common at these sites, including Carex scirpoidea, C. podocarpa, C. saxatalis, and C. misandra. Shrubs were usually absent, although Salix pulchra was locally common at some sites. The forbs Equisetum variegatum, and E. arvense were abundant at these sites. Mosses were common at these sites in areas where ATV impacts were absent. Lichens were rare or absent. Soil profiles for these sites consisted of a well-developed organic layer 10 to 41 cm over mineral soil (n = 12). Frozen soil was found at depths of 19 to 29 cm (n = 4) on 8 July and 12 to 41 cm (n = 8) on 15 July.

Open low willow shrub (IC2g) was sampled in plots AKP062, AKP064, AKP067, AKP068, AKP069, AKP071, AKP072, and K035. These sites were dominated by the willow Salix pulchra. Other common shrubs included Betula nana, Salix lanata, and S. reticulata. Forbs such as Equisetum arvense, and Carex scirpoidea were locally abundant at some sites, but were generally absent or present in trace amounts (less than 1% total cover). Mosses were common, making up 12 to 50 percent of the ground cover. Lichens were scarce or absent altogether. Soil profiles for these plots consisted of an organic layer 7 to 15 cm thick over mineral soil (n = 8). Frozen soil was found at depths of 30 to 47 cm (n = 4) on 7 July.

Dryas dwarf shrub tundra (IID1a) was sampled in plots K025, K026, K027, K028, K030, K031, K033, and K034. These sites were dominated by Dryas integrifolia. Shrubs were not common except for the dwarf willow Salix phlebophylla. Forbs were scarce and mosses were usually absent or present in trace amounts. Lichens were common, but no one species was dominant and none made up 5% or more of the cover at these sites. Soil profiles for these sites consisted of a thin organic layer of 3 to 6 cm over mineral soil (n = 8). Depth to frozen soil could not be determined because of the rocky substrate at these sites.

Tussock tundra (IIIA2d) was sampled in plots K039, K042, K044, K046, K047, and K050. These sites were dominated by the tussock forming sedges Eriophorum vaginatum and Carex bigelowii. Shrubs growing between tussocks included Salix pulchra, Vaccinium uliginosum, and Ledum palustre, but these made up less than 10 percent of ground cover at these sites. Forbs other than the tussock forming species were scarce. Mosses were common, making up 18 to 45 percent of the cover at these sites. Lichens were minimal or absent. Soil profiles for these sites consisted of well developed organic layer 9 to 33 cm over mineral soil (n = 6). Frozen soil was found at a depth of 33 to 40 cm on 14 July (n = 3).

Bearberry dwarf shrub tundra (ID2a) was sampled in plots K022, K023, and K024. These sites were dominated by the shrub Arctostaphylos alpina. The ericaceous shrubs Vaccinium vitis-idaea, and Empetrum nigrum were also common and even codominant at some sites. Forbs such as Hierchloe alpinum and Carex scirpoidea were common at some sites, but were generally scarce. Mosses were absent or rare and lichens were common, although no one species made up 5% or more cover at these sites. Soil profiles for these plots consisted of a thin organic layer 2 to 9 cm over mineral soil (n = 3). Frozen soil was found at a depth of 34 cm at plot K024 on 13 July. Other sites could not be determined due to a rocky substrate.

Vaccinium dwarf shrub tundra (IID2b) was sampled in plots K029, K032, and K052. These sites were dominated by the ericaceous shrub Vaccinium vitis-idaea. Other shrubs that were common at these sites included Empetrum nigrum, Ledum palustre, and Betula nana. Forbs were rare or absent. Mosses and lichens were common, making up 10 to 20 percent of the ground cover at these sites. Soil profiles for these plots consisted of an organic layer 4 to 22 cm over mineral soil (n = 3). Frozen soil was found at a depth of 22 cm on 15 July at plot K052.

Crowberry dwarf shrub tundra (IID2c) was sampled in plots K051 and K055. These sites were dominated by Empetrum nigrum. Other common shrubs included Vaccinium uliginosum, V. vitis-idaea, and Arctostaphylos alpina. Forbs were present in only trace amounts. Mosses were generally absent and lichens were common, although no one species was dominant. Soil profiles for these plots included an organic layer 7 to 9 cm over mineral soil (n = 2). Frozen soil was found at a depth of 39 cm on 15 July at plot K055.

Open low willow-sedge shrub tundra (IIC2h) was sampled in plots K036, K037, and K038. These sites were dominated by the willow Salix pulchra, but also had a strong sedge component of Carex bigelowii. Forbs other than sedges were present, but only in trace amounts. Mosses were common, but lichens were rare. Soil profiles for these sites included an organic layer 6 to 11 cm thick over mineral soil (n = 3). Depth to frozen soil could not be determined de to the rocky substrate found at these sites.

DISCUSSION

This year marks the first full season that ATV impacted plots were established in the park. The majority of the effort was spent trying to establish plots in areas of moderate to high impact in areas of dry and wet moisture content. Without exception, the wettest communities are the most susceptible to ATV damage. Within this moisture class, the most impacted areas are the communities without a woody root base to resist denuding of vegetation (such as wet sedge meadow, IIIA3a). Although communities such as open low willow (IIC2g) also tend to be found in wetter areas, the vegetation does not appear to be as susceptible to denuding. In wet areas, ATV trails sometimes make wide swaths with multiple paths in order to circumvent the wettest areas. Communities with thick woody growth (such as willows) seem to be able to handle the increased trail width without losing the majority of vegetation. Definitive statements about which areas are the most suseptible to ATV impact will not be possible until the current years data is input and analyzed. This will be done during the winter of 1998-1999.

RECOMMENDATIONS

Although an effort was made to establish impact plots in as many different areas as possible, I did not achieve as much coverage of the areas around Anaktuvuk Pass as I would have liked. The major reason for this is the time consuming effort it took to locate areas with the desired level of impact that were also in the desired community types. Another field season is necessary if all impacted community types and moisture classes are to be sampled.

Since the land exchange occurred, here has been little or no increase in ATV trails around the Anaktuvuk Pass area. Most people in the village do not appear to travel farther than one days journey from the village. Overnight camping is not common. Because of this low level of increased use, it should not be necessary to revisit plots every year. Monitoring impacts every 2-3 years should be sufficient at current levels of use. A suggested monitoring plan is described in Appendix C.

Table 1. GPS positions for plots at the Anaktuvuk River, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, July 1997.

Site	Latitude (^{0}N)	Longitude (^{0}W)
AKP050	68^0 07' 33.56"	151^0 11' 33.93"
AKP051	68^0 07' 33.53"	151^0 11' 42.01"
AKP052	68^0 07' 32.18"	151^0 12' 08.99"
AKP053	68^0 07' 32.75"	151^0 12' 18.28"
AKP054	68^0 07' 32.81"	151^0 12' 24.05"
AKP055	68^0 07' 35.32"	151^0 12' 53.78"
AKP056	68^0 07' 11.60"	151^0 15' 38.54"
AKP057	68^0 07' 10.05"	151^0 15' 44.19"
AKP058	68^0 06' 35.94"	151^0 18' 54.97"
AKP059	68^0 06' 31.90"	151^0 18' 52.70"
AKP060	68^0 06' 31.56"	151^0 18' 37.82"
AKP061	68^0 06' 33.63"	151^0 17' 44.06"
AKP062	68^0 06' 39.69"	151^0 17' 00.73"
AKP063	68^0 06' 49.36"	151^0 16' 46.92"
AKP064	68^0 07' 02.03"	151^0 16' 27.35"
AKP065	68^0 06' 33.95"	151^0 19' 06.02"
AKP066	68^0 06' 35.47"	151^0 19' 08.14"
AKP067	68^0 06' 42.75"	151^0 20' 08.34"
AKP068	68^0 06' 42.11"	151^0 20' 12.47"
AKP069	68^0 06' 42.18"	151^0 20' 15.00"
AKP070	68^0 06' 58.11"	151^0 21' 47.41"
AKP071	68^0 06' 51.62"	151^0 21' 15.53"
AKP072	68^0 06' 53.96"	151^0 21' 27.29"
AKP073	68^0 07' 11.40"	151^0 23' 11.94"
AKP074	68^0 07' 11.75"	151^0 23' 08.73"
AKP075	68^0 07' 10.94"	151^0 23' 07.30"
AKP076	68^0 07' 14.05"	151^0 23' 19.10"

Table 2. GPS locations for plots at Kollutaruk Creek/John River, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, July 1998.

Site	Latitude (^{0}N)	Longitude (^{0}W)
K022	68^0 06' 01.41"	151^0 53' 22.23"
K023	68^0 06' 01.99"	151^0 53' 19.87"
K024	68^0 05' 59.69"	151^0 53' 28.62"
K025	68^0 04' 44.82"	151^0 00' 11.36"
K026	68^0 04' 44.40"	152^0 00' 10.09"
K027	68^0 04' 45.06"	152^0 00' 04.83"
K028	68^0 04' 47.00"	151^0 59' 49.05"
K029	68^0 04' 48.17"	151^0 59' 38.95"
K030	68^0 04' 48.90"	151^0 59' 34.63"
K031	68^0 04' 49.33"	151^0 59' 31.25"
K032	68^0 04' 55.66"	151^0 58' 50.76"
K033	68^0 04' 56.91"	151^0 58' 36.29"
K034	68^0 04' 56.96"	151^0 58' 30.26"
K035	68^0 04' 59.15"	151^0 58' 11.97"
K036	68^0 05' 02.81"	151^0 57' 52.75"
K037	68^0 05' 03.45"	151^0 57' 49.06"
K038	68^0 05' 04.87"	151^0 57' 40.62"
K039	68^0 05' 06.23"	151^0 57' 28.98"
K040	68^0 05' 39.80"	151^0 54' 52.40"
K041	68^0 05' 40.38"	151^0 54' 47.10"
K042	68^0 05' 41.21"	151^0 54' 42.95"
K043	68^0 05' 41.66"	151^0 54' 40.78"
K044	68^0 05' 42.03"	151^0 54' 38.83"
K045	68^0 05' 43.41"	151^0 54' 34.38"
K046	68^0 05' 44.37"	151^0 54' 30.86"
K047	68^0 05' 44.91"	151^0 54' 28.68"
K048	68^0 05' 45.90"	151^0 54' 21.62"
K049	68^0 05' 46.08"	151^0 54' 15.60"
K050	68^0 05' 46.70"	151^0 54' 13.35"
K051	68^0 05' 48.05"	151^0 54' 10.86"
K052	68^0 05' 49.10"	151^0 54' 06.32"
K053	68^0 05' 51.78"	151^0 53' 58.39"
K054	68^0 05' 52.58"	151^0 53' 52.67"
K055	68^0 05' 55.77"	151^0 53' 40.16"

Table 3. Soil horizon and texture data collected at the Anaktuvuk River, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, July 1998.

Site	Surface Texture and Thickness (cm)	Subsurface (1) Texture and Thickness (cm)	Subsurface (2) Texture and Thickness (cm)
AKP050	O_i (2.5)	A- Clay Loam (25)	C- Clay (10)
AKP051	O_i (6)	A- Clay Loam (14)	-----
AKP052	O_i (3.5)	A- Clay Loam (6.5)	-----
AKP053	O_i (4)	A- Clay Loam (17)	-----
AKP054	O_i (4)	C- Silty Clay Loam (42)	-----
AKP055	O_i (6)	A- Clay Loam (8)	-----
AKP056	O_i (10)	A- Loam (51)	-----
AKP057	O_i (7)	A- Sandy Clay Loam (5)	-----
AKP058	O_i (9)	A- Clay Loam (12)	A- Sandy Loam (32)
AKP059	O_i (10)	A- Sandy Loam (27)	-----
AKP060	O_i (6)	A- Silty Clay Loam (11)	A- Sandy Clay Loam (8)
AKP061	O_i (8)	A- Clay Loam (15)	-----
AKP062	O_i (10)	A- Clay Loam (6)	-----
AKP063	O_i (15)	A- Clay Loam (33)	-----
AKP064	O_i (11)	A- Clay Loam (23)	-----
AKP065	O_i (8)	A- Sandy Clay Loam (25)	-----
AKP066	O_i (6.5)	A- Sandy Clay Loam (7)	C- Sandy Clay Loam (21)
AKP067	O_i (10)	A- Silty Clay Loam (37)	-----
AKP068	O_i (7)	A- Sandy Loam (59)	-----
AKP069	O_i (8)	A- Sandy Clay Loam (35)	-----
AKP070	O_i (7)	A- Clay Loam (17)	-----
AKP071	O_i (14.5)	A- Silty Clay Loam (15)	-----
AKP072	O_i (14)	A- Silty Clay Loam (28)	-----
AKP073	O_i (20.5)	-----	-----
AKP074	O_i (7.5)	A- Sandy Clay (15)	-----
AKP075	O_i (19)	-----	-----
AKP076	O_i (29)	-----	-----

Table 4. Soil horizon and texture data collected at Kollutaruk Creek/John River, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, July 1998.

Site	Surface Texture and Thickness (cm)	Subsurface (1) Texture and Thickness (cm)	Subsurface (2) Texture and Thickness (cm)
K022	O_i (2)	B- Sandy Clay Loam (19)	-----
K023	O_i (8)	A- Clay Loam (11)	-----
K024	O_i (9)	A- Clay Loam (25)	-----
K025	O_i (6)	A- Sandy Loam (11)	-----
K026	O_i (4.5)	A- Sandy Loam (5)	-----
K027	O_i (5)	A- Sandy Loam (31)	-----
K028	O_i (5)	A- Sandy Loam (12)	-----
K029	O_i (4)	A- Silty Clay Loam (9)	-----
K030	O_i (3)	B- Sandy Loam (12)	-----
K031	O_i (5)	B- Silty Clay Loam (10)	-----
K032	O_i (4)	A- Sandy Loam (9)	-----
K033	O_i (4)	A- Sandy Loam (9)	-----
K034	O_i (4)	B- Silty Clay Loam (19)	-----
K035	O_i (5)	B- Sandy Loam (9)	-----
K036	O_i (6)	A- Clay Loam (6)	B- Sandy Clay Loam (5)
K037	O_i (11)	B- Sandy Clay Loam (10)	-----
K038	O_i (6.5)	A- Clay (15)	B- Sandy Clay (8)
K039	O_i (9)	C- Clay (28)	-----
K040	O_i (7)	C- Clay (26)	-----
K041	O_i (41)	-----	-----
K042	O_i (33)	-----	-----
K043	O_i (8)	C- Clay (24)	-----
K044	O_i (33)	-----	-----
K045	O_i (8)	C- Clay (30)	-----
K046	O_i (16)	C- Clay (24)	-----
K047	O_i (11)	A- Clay Loam (29)	-----
K048	O_i (7)	C- Sandy Clay (17)	-----
K049	O_i (6)	C- Loamy Sand (6)	-----
K050	O_i (14)	-----	-----
K051	O_i (7)	A- Sandy Loam (15)	-----
K052	O_i (22)	-----	-----
K053	O_i (9)	B- Clay (11)	C- Sandy Clay (14)
K054	O_i (12)	B- Clay (10)	-----
K055	O_i (9)	C- Clay Loam (30)	-----

Table 5. Plant list for ATV vegetation impact study, Anaktuvuk Pass, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, 1996-1998.

CODE	Plant Name
ACODEL	Aconitum delphinifolium
ALNCRI	Alnus crispa
ANDPOL	Andromeda polifolia
ANEMUL	Anemone multifida
ANENAR	Anemone narcissiflora
ANEPAR	Anemone parviflora
ANERIC	Anemone richardsonii
ARALYR	Arabis lyrata
ARAXXX	Arabis spp.
ARCLAT	Arctagrostis latifolia
ARCALP	Arctostaphylos alpina
ARCRUB	Arctostaphylos rubra
ARTARC	Artemisia arctica
ARTGLO	Artemisia glomerata
ARTTIL	Artemisia tilesii
ARTXXX	Artemisia spp.
ASACHR	Asahinia chrysantha
ASTSIB	Aster sibiricus
ASTALP	Astragalus alpinus
ASTUMB	Astragalus umbellatus
BETNAN	Betula nana
BOYRIC	Boykinia richardsonii
CALCAN	Calamagrostis canadensis
CAMUNI	Campanula uniflora
CARAQU	Carex aquatilis
CARBIG	Carex bigelowii
CARMEM	Carex membranaceae
CARMIC	Carex michrocheata
CARMIS	Carex misandra
CARNES	Carex nesophila
CARPLE	Carex pleuroflora
CARPOD	Carex podocarpa
CARROT	Carex rotundata
CARSAX	Carex saxatalis
CARSCI	Carex scirpoidea
CARXXX	Carex spp.

Table 5 (Cont.)

CODE	Plant Name
CARSTY	Carex stylosa
CASTET	Cassiope tetragona
CASHYP	Castilleja hyperborea
CETCUC	Cetraria cucullata
CETISL	Cetraria islandica
CETNIV	Cetraria nivalis
CHRTET	Chrysosplenium tetrandrum
CLARAN	Cladina rangiferina
CLAXXX	Cladonia spp.
DICXXX	Dicranum spp.
DODFRI	Dodecatheon frigidum
DRYINT	Dryas integrifoila
EMPNIG	Empetrum nigrum
EPIANG	Epilobium angustifolium
EPILAT	Epilobium latifolium
EQUARV	Equisetum arvense
EQUVAR	Equisetum variegatum
ERIANG	Eriophorum angustifolium
ERIRUS	Eriophorum russeolum
ERIXXX	Eriophorum spp.
ERIVAG	Eriophorum vaginatum
FESALT	Festuca altaica
FESRUB	Festuca rubra
GENGLA	Gentiana glauca
GEUGLA	Geum glaciale
GEUROS	Geum rosii
HEDXXX	Hedysarum spp.
HEDALP	Hedysarum alpinum
HEDMAC	Hedysarum mackenzii
HIEALP	Hierchloe alpina
HIPVUL	Hippurus vulgaris
HYLSPL	Hylocomnium splendens
JUNCAS	Juncus castaneus
JUNXXX	Juncus spp.
LEDPAL	Ledum palustre
LICHE1	Lichen

Table 5 (Cont.)

CODE	Plant Name
LUZXXX	Luzula spp.
MASRIC	Masonhalea richardsonii
MINARC	Minuartia arctica
OXYCAM	Oxytropis campestris
OXYMAY	Oxytropis maydelliana
OXYNIG	Oxytropis nigrescens
PAPALA	Papaver alaskanum
PAPLAP	Papaver lapponicum
PARPAL	Parnassia palustris
PARNUD	Parrya nudicaulis
PEDCAP	Pedicularis capitata
PEDKAN	Pedicularis kanei
PEDLAB	Pedicularis labradorica
PEDLAN	Pedicularis langsdorfii
PEDXXX	Pedicularis spp.
PEDSUD	Pedicularis sudetica
PETFRI	Petasites frigidum
PHLSIB	Phlox sibirica
PLESCH	Pleurozium schreberi
POAALP	Poa alpigena
POAARC	Poa arctica
POAXXX	Poa spp.
POLACU	Polemonium acutiflorum
POLBIS	Polygonum bistorta
POLVIV	Polygonum vivaparum
POTBIF	Potentilla biflora
POTFRU	Potentilla fruticosa
POTUNI	Potentilla uniflora
PYRGRA	Pyrola grandiflora
RHOLAP	Rhododendron lapponicum
RUBCHA	Rubus chamaemorus
RUMARC	Rumex arcticus
SALALA	Salix alaxensis
SALARC	Salix arctica
SALFUS	Salix fuscecens
SALGLA	Salix glauca

Table 5 (Cont.)

CODE	Plant Name
SALLAN	Salix lanata
SALPHL	Salix phlebophylla
SALPUL	Salix pulchra
SALRET	Salix reticulata
SAUANG	Saussurea angustifolia
SAXBRO	Saxifraga bronchialis
SAXHIE	Saxifraga hieracifolia
SAXHIR	Saxifraga hirculus
SAXOPP	Saxifraga oppositifolia
SAXPUN	Saxifraga punctata
SAXTRI	Saxifraga tricuspidata
SENLUG	Senecio lugens
SHECAN	Shepherdia canadensis
SILACA	Silene acaulis
SOLMUL	Solidago multiradiata
STECRA	Stellaria crassifolia
STETOM	Stereocaulon tomentosum
THASUB	Thamnolia subuliforma
TOMNIT	Tomenthypnum nitens
TRISPI	Trisetum spicatum
VACULI	Vaccinium uliginosum
VACVIT	Vaccinium vitis-idaea
VALCAP	Valeriana capitata
WILPHY	Wilhelmsia physodes
ZYGELE	Zygadenus elegans

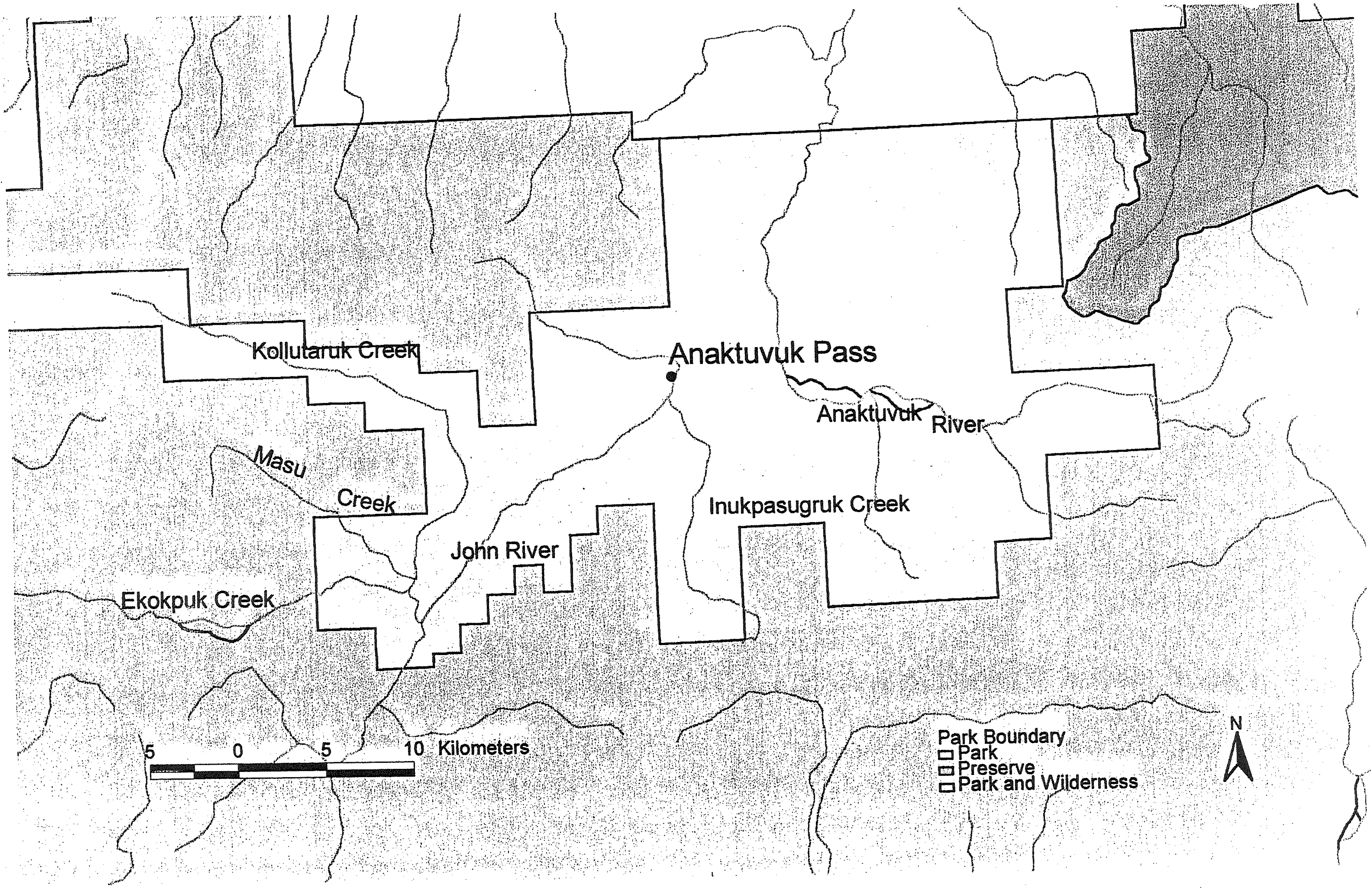


Figure 1. Location of ATV study, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, July 1998.

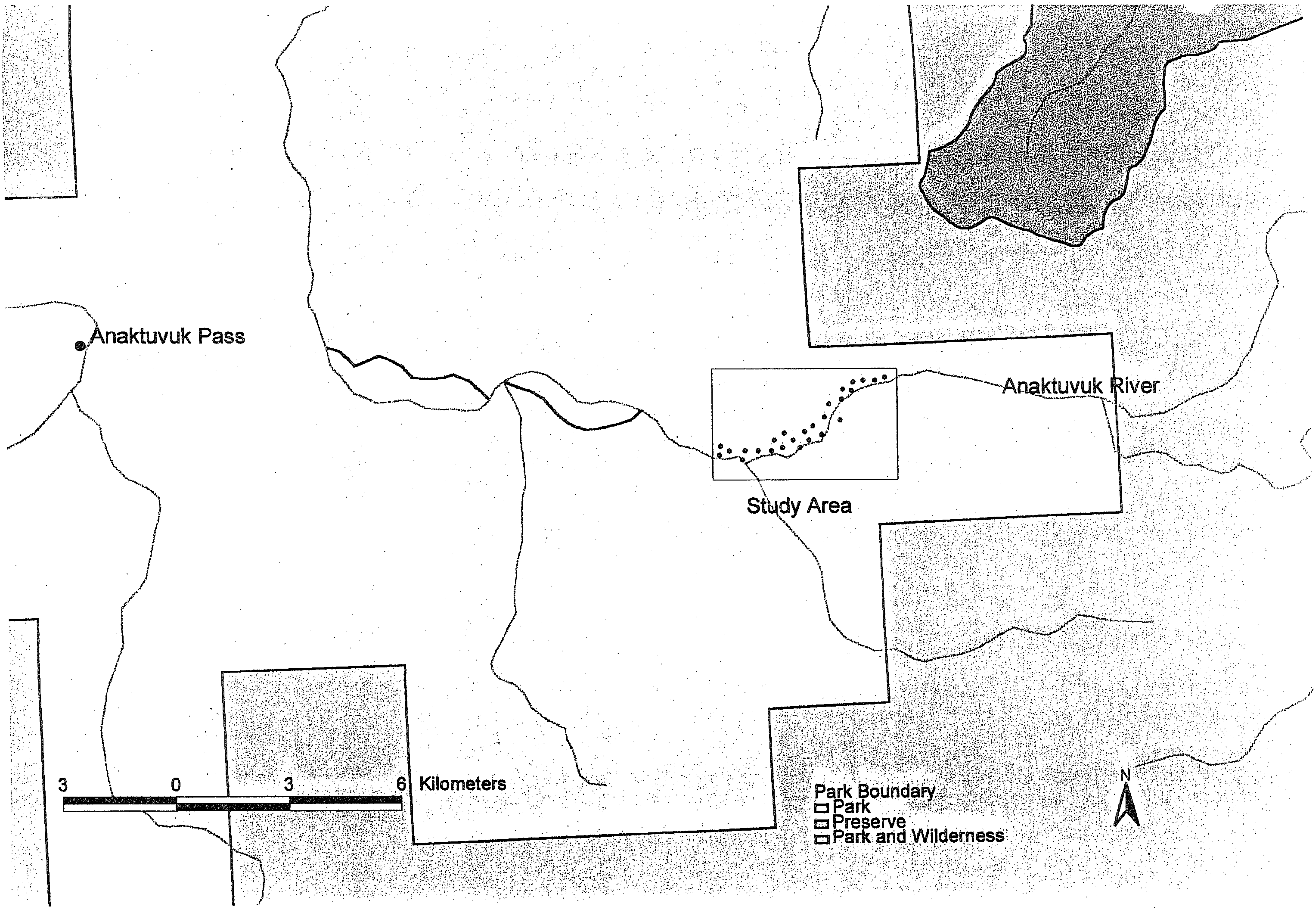
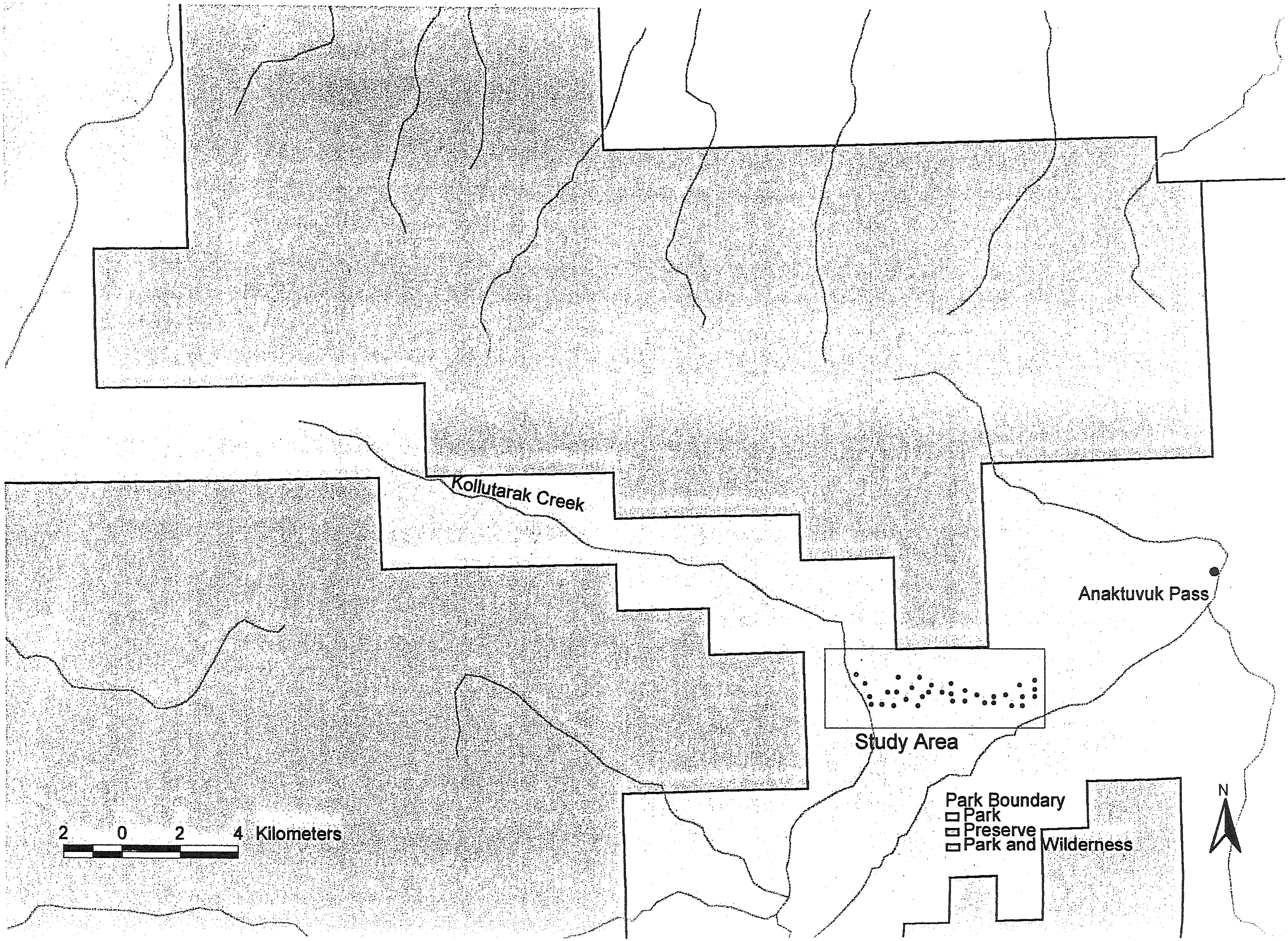


Figure 2. Location of study plots, Anaktuvuk River, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, July 1998.


Kollutarak Creek
Anaktuvuk Pass
Study Area
Park Boundary
Park
Preserve
Park and Wilderness
N
2 0 2 4 Kilometers

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Appendix A. ATV study data form, Anaktuvuk Pass, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, 1998.

ANAKTUVUK PASS ATV IMPACT STUDY: VEGETATION AND SOILS SURVEY

Plot #__________ Plot Code____________ Date______ Observers__________

Plot Location____°____'____" N; ____°____'____" W

Vegetation Type: ____

Vegetation

____ Anemone narcissiflora
____ Andromeda polifolia
____ Betula glandulosa
____ Betula nana
____ Calamagrostis canadensis
____ Carex bigelowii
____ Cassiope tetragona
____ Dryas drummondii
____ Dryas integrifolia
____ Empetrum nigrum
____ Epilobium latifolium
____ Eriophorum vaginatum
____ Ledum palustre
____ Rubus chamaemorus
____ Salix lanata
____ Salix pulchra
____ Salix reticulata
____ Vaccinium uliginosum
____ Vaccinium vitis-idaea
____ ___________
____ ___________
____ ___________
____ ___________
____ ___________
____ ___________
____ ___________
____ ___________
____ ___________
____ ___________

Lichens

____ ___________
____ ___________
____ ___________
____ ___________

Environmental Variables

______ Slope (deg)
______ Aspect (deg True N)
______ Elevation (m)
______ % Total Vascular Cover
    ______ % Shrub Cover
    ______ % Forb Cover
______ % Total Lichen Cover
______ % Total Bryophyte Cover
______ Mean Shrub Height (cm)
______ % Cover Litter
______ % Cover Bare Soil
______ % Standing Water
______ % Rock

Comments/Drawing

Impacts

______ Evidence of ATV traffic
______ %Shrub damage
______ % Cover shrubs damaged
______ % Cover abraded shrubs

______ Disturbance Level
______ Soil Exposed
______ Microrelief
______ Visual Description
______ Vegetation

Appendix A Cont.

Soils
Surficial Geology: organic mineral gravel bedrock

Surface Texture and approx. thickness (cm)

____

Subsurface (1) Texture and approx. thickness (cm)

____

Subsurface (2) Texture and approx. thickness (cm)

____

Subsurface (3) Texture and approx. thickness (cm)

____

Subsurface (4) Texture and approx. thickness (cm)

____

Topographic position: ridge midslope lowerslope valley bottom riparian

Depth to (cm):
_____ bedrock
_____ permafrost
_____ water table
_____ saturated soil
_____ gleying
_____ high chroma mottles

Buried organic horizon? (Y or N) _______________

Evidence of flooding? (Y or N) _______________
If yes, flooding > 1x/yr? (Y or N) _______________

____

Appendix B. Disturbance Rating Scale for ATV study, Anaktuvuk Pass, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, 1998.

Disturbance Level	Description
Vegetation:	
1	Undamaged; no discernable change
2	Slight compression; leaves or stems temporarily bent or rearranged; vehicle passage barely perceptible.
3	Mosses, graminoids and other herbaceous species compressed and leaves flattened; shrub stems becoming compressed.
4	Leaves or mosses and lichens torn or removed; woody shrub stems flattened, with some breakage and abrasion.
5	11-25% of original vegetation composition not discernible
6	26-50% not discernible
7	51-75% not discernible
8	76-100% not discernible

Soil:

1	None exposed	5	26-50% exposed
2	1-5% exposed	6	51-75% exposed
3	6-10% exposed	7	76-90% exposed
4	11-25% exposed	8	91-100% exposed

Microrelief:

1	No discernible change or depression of the surface
2	Tracks evident but with less than half of track depressed 1 inch; slight compression of tussocks or hummocks.
3	Surface depression less than 1 inch over majority of track; slight to moderate compression of tussocks or hummocks.
4	Track depressed 1-2 inches; moderate tussock or hummock compression.
5	Track depressed 2-4 inches; moderate to severe tussock or hummock compression.
6	Tracks depressed 4-6 inches; severe tussock or hummock depression.
7	Track depressed 6-8 inches; severe compression or destruction of tussocks or hummocks.
8	Depression or ruts greater than 8 inches deep; tussocks or hummocks completely flattened or destroyed.

Impact level determined by adding up the 3 categories of impacts: high (16-24), moderate (10-15), and low (0-9).

Appendix C. Suggested plan for monitoring All-Terrain vehicle impacts on vegetation around Anaktuvuk Pass, Gates of the Arctic National Park and Preserve, Brooks Range, Alaska.

DESCRIPTION: Approximately 200 vegetation study plots have been established in several of the drainage's surrounding Anaktuvuk Pass. These plots consisted of two types: 1. Baseline/pre-impacted sites, and 2. ATV impacted sites. In order to assess the degree to which various vegetation types are susceptible to ATV damage, both types of sites will need to be monitored. The following describes one way in which this could be accomplished.

Baseline Sites: These sites should be monitored for the appearance of ATV trails. Once it is determined that impacts have begun in these areas, sampling of these sites should proceed in the same manner in which other sites have been conducted. These sites should be monitored every 1-2 years so that the progression of impacts in these areas can be closely followed.

Impacted Sites: Since the initial information on the content of these sites (vegetation type, soil type, topographic aspects) have already been collected, monitoring of these sites should concentrate on examining impact features. This would include the following: 1. Percent cover of vegetation and bare soil to assess the degree to which ATV use is denuding the vegetation at these sites; this can further be broken down into types of vegetation (i.e. shrubs, forbs, lichens, and mosses) so that the relative susceptibility of various plant types to ATV impact can be assessed, 2. Depth of ATV ruts to assess the resistance of the soil types in these areas to compaction, 3. Overall width of trail over time. All of these impacts can be monitored with the same disturbance rating scale used in the past. As mentioned before, these sites should be monitored every two to three years to allow for a detectable change in impact.

SAMPLING SCHEME: In order to attain a sufficient sample size for analysis, at least 10 plots per vegetation type, per impact class should be sampled. This would give us a total of 30 plots per vegetation type (10 plots in low, moderate, and high impact classes each). Since the number of plots that will be able to be sampled will somewhat be determined by the extent of available impacts, this is an ideal sample size. In addition, sampling should be conducted in as many different moisture regimes (i.e. dry, moist, wet) as possible. In order to maximize sampling efficiency, I suggest that sampling effort be focused on areas most easily accessed by ATV's. This seems to be related to the distance of various drainages from Anaktuvuk Pass. Therefore, drainages should be sampled in the following order: Giant (Inukpasugruk) Creek, lower Anaktuvuk River, upper Anaktuvuk River/Graylime Creek, Kollutaruk Creek, Masu Creek, and Ekokpuk Creek.

DATA INPUT AND ANALYSIS: Data collected for this study will be stored in Microsoft *Access* (Version 2.0) databases. All previous and future data will be stored in this fashion. Data analysis will be conducted using Multi-response Permutation Procedure (MRPP), to test the null hypothesis of no difference between pre and post-impacted plots. Ordination techniques will be used to determine differences between plots (i.e. percent bare soil , species richness, percent vegetation cover). For a description of ordination, see NPS (1997). After using ordination to determine which parameters (bare ground, vegetation cover, soil type, moisture class, etc.) are important in separating plots, ANOVA will be used to examine the most important variables. Multivariate analyses will be performed using a software package called PC-ORD.